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**1 The MONARC toolset for simulating large network-distributed proce
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Simulation Conference, 2000. Proceedings. Winter , Volume: 2 , 2000

Page(s): 1794 -1801 vol.2

[\[Abstract\]](#) [\[PDF Full-Text \(928 KB\)\]](#) **CNF**

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 Print Format[SEARCH RESULTS](#) [\[PDF Full-Text \(120 KB\)\]](#) [PREVIOUS](#) [NEXT](#)Heterogeneous distributed virtual machines in the Harness metacomputing framework - *Migliardi, M.; Sunderam, V.*

Editor(s): Prasanna, V.K.

Dept. of Math. & Comput. Sci., Emory Univ., Atlanta, GA, USA

This paper appears in: Heterogeneous Computing Workshop, 1999. (HCW '99) Proceedings. Eighth

On page(s): 60 - 72

12 April 1999

San Juan, Puerto Rico

1999

ISBN: 0-7695-0107-9

Number of Pages: x+219

References Cited: 15

INSPEC Accession Number: 6240855

Abstract:

Harness is a Java-centric, experimental metacomputing framework based upon principle of dynamic enrolment and reconfiguration of heterogeneous computational resources into distributed virtual machines. The dynamic behavior of the system is limited to the number and types of computers and networks that comprise the machine, but also extends to the capabilities of the virtual machine itself. The fundamental characteristics address the inflexibility of current metacomputing frameworks as well as their incapability to easily incorporate new, heterogeneous technologies and architectures and avoid rapid obsolescence. The adaptable Harness derives both from a user controlled, distributed "plug-in" mechanism and an event driven, dynamic management of the distributed virtual machine state. Central features of the system.

Index Terms:

virtual machines; reconfigurable architectures; object-oriented programming; programming; workstation clusters; Harness; heterogeneous distributed virtual machines; Java-centric experimental metacomputing framework; dynamic enrolment; dynamic reconfiguration; heterogeneous computational resources; networks; controlled distributed plug-in mechanism; event driven dynamic management

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L5: Entry 1 of 20

File: USPT

Sep 18, 2001

US-PAT-NO: 6292267

DOCUMENT-IDENTIFIER: US 6292267 B1

TITLE: Network printer apparatus and LAN network system

DATE-ISSUED: September 18, 2001

INVENTOR-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY
Mori; Yoshio	Kawasaki			JPX
Abe; Fumitake	Kawasaki			JPX
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Ito; Mari	Kawasaki			JPX
Sato; Toshimi	Kawasaki			JPX
Saitoh; Yasushi	Kawasaki			JPX
Kida; Yasunari	Kawasaki			JPX

ASSIGNEE-INFORMATION:

NAME	CITY	STATE	ZIP CODE	COUNTRY	TYPE CODE
Fujitsu Limited	Kawasaki			JPX	03

APPL-NO: 8/ 848449

DATE FILED: May 8, 1997

PARENT-CASE:

This is a continuation, of application Ser. No. 08/292,110, filed Aug. 17, 1994.

FOREIGN-APPL-PRIORITY-DATA:

COUNTRY	APPL-NO	APPL-DATE
JP	5-286806	November 16, 1993
JP	6-048423	March 18, 1994

INT-CL: [7] G06F 15/00

US-CL-ISSUED: 358/1.15; 709/230

US-CL-CURRENT: 358/1.15; 709/230

FIELD-OF-SEARCH: 358/1.1, 358/1.6, 358/1.9, 358/1.12, 358/1.13, 358/1.14, 358/1.15, 712/229, 712/1, 709/200, 709/201, 709/202, 709/217, 709/218, 709/221, 709/229, 709/230, 709/249, 709/358, 710/61, 710/72, 710/105, 710/261, 395/101, 395/106, 395/109, 395/111, 395/112, 395/113, 395/114, 229/570, 229/800, 229/200.3, 229/200.31, 229/200.32, 229/200.47, 229/500, 229/501, 229/408, 229/409, 229/437

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Tsuchiya, Shinichi, "Page Printers for Direct Connection to NET", Oct. 4, 1993, Nikkei Communications.

ART-UNIT: 274

PRIMARY-EXAMINER: Popovici; Dov

ASSISTANT-EXAMINER: Garcia; Gabriel I.

ATTY-AGENT-FIRM: Helfgott & Karas, P.C.

ABSTRACT:

A high-speed network printer apparatus which can be used in common by clients having different communication protocols and which can sort out printing jobs into the order of clients. Printing information is supplied from a client which may be a personal computer or a work station through a connector of the printer apparatus. A LAN interface driver receives the printing information and identifies a communication protocol by which the printing information is transferred. A communication protocol controller receives printing information in accordance with a predetermined protocol. A spooling controller, which is coupled to a storage unit which stores the received printing information, creates a queue for printing jobs. A printer controller reads out from the storage unit the printing information corresponding to a printing job of the highest priority which is designated by the queue, and forms a dot image on the

basis of the printing information. A printing mechanism prints the image on paper. A mailbox stores printed paper into a designated bin. A printing job table is provided in the printer apparatus, in which each row is allotted to one printing job which includes a field for storing an emulation program name. A registering unit judges whether or not there is a another printing job having the same emulation program name to expedite the printing process.

39 Claims, 72 Drawing figures

WEST☐ Generate Collection

L5: Entry 3 of 20

File: USPT

Nov 9, 1999

DOCUMENT-IDENTIFIER: US 5982994 A

TITLE: Network printer apparatus and LAN network system

ABPL:

A high-speed network printer apparatus which can be used in common by clients having different communication protocols and which can sort out printing jobs into the order of clients. Printing information is supplied from a client which may be a personal computer or a work station through a connector of the printer apparatus. A LAN interface driver receives the printing information and identifies a communication protocol by which the printing information is transferred. A communication protocol controller receives printing information in accordance with a predetermined protocol. A spooling controller, which is coupled to a storage unit which stores the received printing information, creates a queue for printing jobs. A printer controller reads out from the storage unit the printing information corresponding to a printing job of the highest priority which is designated by the queue, and forms a dot image on the basis of the printing information. A printing mechanism prints the image on paper. A mailbox stores printed paper into a designated bin. A printing job table is provided in the printer apparatus, in which each row is allotted to one printing job which includes a field for storing an emulation program name. A registering unit judges whether or not there is a another printing job having the same emulation program name to expedite the printing process.

DEPR:

In order to display a list of printing jobs, a list of fonts and a list of overlays in the network printer apparatus 20, the item "Display" is picked out of the menu 41. A menu 44 of selecting a list is then displayed and a desired list is designated. The menu controller 31a creates an enquiry command/operand ("Job", "Font", "Form overlay", etc.) and inputs it to the printing request controller 31d. When the printing request controller 31d receives the inquiry command/operand, it inputs the request for inquiry about the designated list to the communication controller 31e. The communication controller 31e transmits the request for inquiry to the network printer apparatus 20 by the original communication protocol. The network printer apparatus 20 then sends the demanded list to the client. The menu controller 31a receives the list through the communication controller 31e and the status controller 31d and displays it on the display screen.

DEPR:

In order to confirm the printing service state and the printer operation state, the item "Printing service state" 41c or the item "Printer operation state" is picked out of the menu 41. The menu controller 31a creates the inquiry command operand ("Printing service state", "Printer operation state", etc.) and inputs them to the printing request controller 31d. The printing request controller 31d inputs a request for the designate data to the communication controller 31e, and the communication controller 31e transmits it to the network printer apparatus 20 by the original communication protocol. The network printer apparatus 20 then sends the demanded data on the printing service state or the printer operation state to the client. The menu controller 31a receives the data through the communication controller 31e and the status controller 31d and displays it on the display screen.

DEPR:

The status controller 31b monitors the data from the communication controller 31d, and when the data is a message of abnormality, the status controller 31b transmits it to the menu controller 31a (Step 603). When the menu controller 31a receives the message, it automatically displays the abnormality of the network printer apparatus 20 on the display screen (Step 604).

network printer apparatus 20 on the display screen (Step 604).

WEST☐ Generate Collection

L5: Entry 11 of 20

File: USPT

Jul 28, 1998

DOCUMENT-IDENTIFIER: US 5787237 A

TITLE: Uniform interface for conducting communications in a heterogeneous computing network

ABPL:

A network printing system for enhancing two-way communication between host computers and printers connected to a network. More particularly, the network printing system provides an imaging device protocol (DP) which enables various network service protocol/ports for host computers to communicate with the printer by "seamless plug and play" connectivity. IDP operates independently of the network layers below and only requires that the transport protocol/port be bidirectional. IDP allows all of the incoming print job information to be placed in the print queue regardless of the protocol for a wide variety of heterogeneous network protocols. As a result, the network printing system enables print jobs from host computers connected to the network by a wide variety of heterogeneous network protocols to be fairly arbitrated at the printer.

DEPR:

The print queue 82 is used to queue the job information for all of the print jobs that have an outstanding print request to the printer 410 from any of the host computers 400.sub.0 . . . n connected to the network. The print queue 82 enables all of the pending jobs from the host computers to be displayed to any of the host computers in addition to displaying only jobs queued from a particular host computer in known print systems. In a print protocol for an embodiment of the present invention, many commands may be used to communicate with the print queue 82 for enhancing the communication between the host computers 400.sub.0 . . . n and the printer 410. Some examples of the commands for the print protocol in the present embodiment are: print job request; transmit job; enumerate queue; get job information; get job status; cancel job; query print device; sent print device configuration; get accounting log; alert; job status; enumerate job IDs; hold job; remove job; update job information; enumerate print device; lock print device; unlock print device; connect to event; disconnect from event; reconnect to event; check some data; and reset event log commands.

DEPR:

An example of using the print protocol to enhance the communication with the print queue 82 will be discussed for the print job request command for an embodiment of the present invention. Prior to sending a job request from one of the host computers 400.sub.0 . . . n, the requesting host computer sends a print job request to the printer 410 and a job ID is returned from the printer 410 to the requesting host computer. When the printer 410 accepts this print request, the job information for the print job as provided by the requesting host computer is placed in the print queue 82. For this print job request call, the parameters stored in the print queue 82 include job information job name, estimated time to print, document status, number of pages in the document, pages left to print, image content, user comments, media and creator application) and information for notifying the requesting host computer that the actual job data residing at the requesting host computer can be accepted by the printer. When the printer 410 notifies the requesting host computer that the actual job data may be captured, a transmit job command is transmitted from the printer which initiates the sending of the actual job data from the requesting host computer to the printer 410. When a print job is completed for a requesting host computer, this request is removed from the print queue 82 and placed into a job log. The job log may also be implemented in the RAM 414. All of the information associated with the print job request call and stored in the print queue 82 may be accessed and displayed by any of

call and stored in the print queue 82 may be accessed and displayed by any of the host computers 400.sub.0 . . . n connected to the network at any time.

WEST☐ Generate Collection

L5: Entry 17 of 20

File: USPT

Oct 22, 1996

DOCUMENT-IDENTIFIER: US 5568612 A

TITLE: Method and apparatus for advertising services of two network servers from a single network node

ABPL:

Method and apparatus for advertising two network servers from a single network node in a LAN communication system which supports advertising only a single network server from any one node. A surrogate server is configured at the network node to listen for network broadcasts to a proprietary socket and then interleavedly advertises that the services of the first and second network servers (the "client" servers) are available from the node. When a network broadcast request addressed to the proprietary socket is received, the surrogate server responds to the request if directed to one of its clients, thereby permitting direct communication to be established with the designated one of the first or second network servers, for example, over the communication socket which is different from the proprietary socket.

DEPR:

At Step S28, the microprocessor 216 retrieves the requested status data from DRAM 220, assembles the status data, and sends it to the LAN through the LAN interface (to be discussed in greater detail in section 4i below). Thus, in Step S28, more than simple "on/off" information may be transmitted to the LAN so as to inform the LAN of the detailed status of the printer. In a broad application, Step S28 encompasses the export of printer front panel status over the LAN, and the import of front panel control commands from the LAN. That is, the network administrator at the PC 14 may request and receive a display indicating all of the printer information included on the printer front panel display 116. The network administrator may then activate different printer front panel functions on his/her PC, and such functions will be transmitted to the printer where the selected control will be effected.

WEST

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L5: Entry 18 of 20

File: USPT

Jul 16, 1996

DOCUMENT-IDENTIFIER: US 5537626 A

TITLE: Apparatus for coupling printer with LAN to control printer operation by transferring control parameters, printer status data and printer configuration data between printer and LAN

ABPL:

Method and apparatus for interfacing a printer to a local area network utilizes a circuit board coupled to the printer. A Small Computer System Interface (SCSI) is disposed on the board for transmitting print data to the printer and for receiving printer status data from the printer. A RAM is also disposed on the board, for storing the print data, the printer status data, and a plurality of application programs. A Local Area Network (LAN) interface is also disposed on the board, for receiving the print data from the LAN, and for transmitting the printer status data to the LAN. A processor is disposed on the board, for executing the plurality of application programs to cause the print data to be transmitted to the printer and the printer status data to be transmitted to the LAN. Preferably, printer control data may also be transmitted over the LAN to control printer functions.

DEPR:

At Step S28, the microprocessor 216 retrieves the requested status data from DRAM 220, assembles the status data, and sends it to the LAN through the LAN interface (to be discussed in greater detail in section 4i below). Thus, in Step S28, more than simple "on/off" information may be transmitted to the LAN so as to inform the LAN of the detailed status of the printer. In a broad application, Step S28 encompasses the export of printer front panel status over the LAN, and the import of front panel control commands from the LAN. That is, the network administrator at the PC 14 may request and receive a display indicating all of the printer information included on the printer front panel display 116. The network administrator may then activate different printer front panel functions on his/her PC, and such functions will be transmitted to the printer where the selected control will be effected.

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L3: Entry 1 of 1

File: USPT

Mar 10, 1998

DOCUMENT-IDENTIFIER: US 5727135 A

TITLE: Multiple printer status information indication**ABPL:**

Bidirectional communications between a host computer and a selected printer connected to the host, either locally or by way of a network, are used to provide a user of the host with access to a substantially real-time, visual and functional replica of the operator panel of the selected printer. A user at the host computer may also visually monitor the status of multiple printers at the same time from the same host display.

BSPR:

This invention relates to the monitoring and control of printers serving one or more host computers. More particularly, this invention relates to providing status information for multiple printers at the site of one or more host computers in bidirectional communication with the printers.

BSPR:

Printers receive print data from a source such as a host computer and generate a printed representation of that print data on a page. A printer can serve either single or multiple hosts. For example, a printer may be connected by cable directly to the serial or parallel port of the host to serve that host only. Alternatively, a printer interfaced to a network can be assigned to multiple hosts residing on that network. In either case, it is sometimes necessary or desirable that printers be located where they are not readily physically accessible or are obscured from the view of a user of a given host. It may then be inconvenient, or even impossible for such a user to view and use the operator panel of such a printer, or to directly observe the status of multiple printers available to the host.

BSPR:

Printer operator panels vary in configuration but generally provide both monitoring and manual control capability. Manual control may be carried out by way of control devices such as pushbutton switches which are in some cases permanently labelled and perform dedicated functions. Pushbuttons may also be positioned in relation to a liquid crystal or other display capable of providing changeable legends so that a single pushbutton can be associated with several variable functions. Status indications and other monitoring functions may be implemented with the aid of indicator lights, audible alarms and/or messages appearing on a menu-driven liquid crystal or other alphanumeric display. Such facilities typically provide control capabilities ranging from rudimentary power switching and indication of whether the printer is in an on-line or ready status to a variety of more sophisticated functions such as selecting paper size, paper source, font, point size, pitch, manual or automatic feed, print orientation, duplex (double sided printing) mode, lines per page, diagnostic testing and/or others. Monitoring functions may include providing any of a number of visual and/or audible indications informing a user of the condition or service needs of the printer. These indications may take the form of status messages such as "ready" or "busy" which indicate the current condition of the printer. They may also take the form of attendance messages such as "paper jam," "load paper," "toner low" or "top cover open" calling for intervention by the operator or service error codes indicating problems requiring the attention of a service technician.

BSPR:

Efforts have been made to provide network administrators and users with some

capability to monitor and control a remote printer. Exemplary of these are the Hewlett-Packard Company software utilities known as JetAdmin.RTM. and JetPrint.RTM.. JetAdmin.RTM. is an administrative utility for configuring, managing and troubleshooting Hewlett-Packard JetDirect.RTM. printers on a network such as Novell NetWare.RTM. network. Operable as either a Microsoft Windows application or as a DOS application, JetAdmin.RTM. allows a network administrator to perform a number of tasks relating to a printer located anywhere on the network. For example, the administrator can gather status information and display the operational status and connection status of a given printer on the screen of the host computer by using a mouse or other pointing device to select (i.e., "click on") the "status" button appearing thereon. A printer can also be remotely configured to operate either in a remote printer mode or a queue server mode. In the queue server mode, no separate print server is required. Print data from a host is communicated to a file server where it is spooled in a print queue. When the selected printer is available, a queue server running on the HP JetDirect.RTM. interface transfers the job to the printer for printing. In the remote printer mode, the print data spooled in the file server is copied to the selected printer by a dedicated print server. The JetAdmin.RTM. utility also permits a network administrator to add or delete queues or file servers and to remotely install, select or remove printer drivers. Clicking on a "Diagnostics" button presents a Printer I/O Diagnostics screen which includes buttons for specifying information to be displayed. A colored indicator to the left of each button is green when the item appears to be functioning normally and turns yellow in the event of a problem. Clicking on a "Test Page" button appearing on the Printer I/O Configuration screen permits a test page to be printed in any of a number of printer languages.

BSPR:

JetPrint.RTM. is a Microsoft Windows based utility which permits network users to perform "drag and drop" printing, view printer and interface status, install Windows drivers, set up a default print queue for all Windows jobs and assign sounds to selected printer events. To view the status of a network printer from the host, a user running JetPrint.RTM. selects a printer or print queue in order to display configuration information, list jobs queued or display printer status or printer description information. An icon in the form of a stoplight may be clicked on in order to display an explanation of the status of a printer on the network.

BSPR:

While the foregoing capabilities are useful, there are a number of problems which have not been recognized or solved by the prior art. For example, the JetAdmin.RTM. and JetPrint.RTM. utilities described above communicate by way of network command protocols. Consequently, these utilities function only with respect to printers coupled to a host by way of a network and lack ability to perform functions requiring bidirectional communication (such as the display of printer status, printer description, configuration and queue information) with a printer which may be connected to the host "locally" i.e., by way of direct coupling to a serial or parallel printer port of the host. As a result, a user may not be able to display the status, description or configuration of any printer available to their host.

BSPR:

Another problem has been that printer status, configuration and condition information presented at any given time on the operator panel of a printer has not always been available substantially instantaneously at any host served by that printer, and vice versa. Consequently, complete, accurate and current information has not been available at the host and the printer operator panel simultaneously. To the extent status information relating to a networked remote printer has been available to a host, it has heretofore been necessary for the host to acquire that information by polling. This increases network traffic and thereby degrades the speed and performance of the network.

BSPR:

The system described herein overcomes the above-described problems and deficiencies by providing the user of a host computer with access to a substantially real-time visual and functional replica of the operator panel of a printer available to that host. This replica can be provided whether the printer is connected to the host through a network or by a local connection.

The present system thus provides the user, without leaving the host, with the ability to access and use all features of the printer operator panel to the same extent that a person could if physically present at the site of the printer itself. Using the replica generated on the display of the host, a host user can effectively "view" the actual printer operator panel in substantially real-time. The user may thus be informed of status, attendance or service messages appearing on the actual printer operator panel and have benefit of any operating instructions or prompts which may be available there. Using a mouse or other convenient input device, the user of the host can also effectively "actuate" the pushbuttons or other operator panel control devices depicted as part of the replica.

BSPR:

In accordance with the present invention, the described system also provides the ability for a user at a host to visually monitor the status of multiple printers at the same time from the same host display. In order to do this, the host display is capable of showing a list of printers available to the host in which changes in state of any of the printers are shown.

DEPR:

Printer 16 will also typically include an operator panel 35 having one or more indicator lights and/or an alphanumeric display for providing information to a human operator. Such information may comprise status messages, attendance messages, service messages, instructions and/or prompts. Operator panel will also include one or more control devices such as selector switches, pushbuttons or others useful for controlling the operation of printer 16.

DEPR:

As FIG. 2 indicates, Printer Panel 51 may be described as a plurality of separate but intercommunicating software substituents. Those include a Graphical User Interface (GUI) 53, a Printer Driver 55, a Local Interface 57, a Network Interface 59 and an NPAP Processor 60 to which each of the foregoing is linked. The Network Printer Alliance Protocol (NPAP) is a published protocol specification Level 1, Revision N of which dated Feb. 11, 1994 is expressly incorporated herein by reference in its entirety. The NPAP specification defines a bidirectional mode of communication between a host and a mutually compatible printer as a means of returning printer status information to the host. Copies of NPAP are presently available via anonymous FTP from ftp ftp.lexmark.com [192.146.101.4]. The preferred embodiment described herein is implemented using command extensions of NPAP as will be explained in further detail below.

DEPR:

As noted earlier, printer 16 includes an operator panel 35 which, in the preferred embodiment includes a four line, menu-driven alphanumeric display 37. Each line of display 37 is positionally associated with one of four respective variable function pushbuttons 40a, 40b, 40c and 40d. Changeable legends such as legend 42 appearing to the left of one or more of pushbuttons 40a, 40b, 40c and 40d indicate the function which, at any given time can be performed by actuating that pushbutton. Operator panel 35 also includes a dedicated "Ready" pushbutton 45 and a dedicated "Return" pushbutton 46. The former is used to return printer 16 to the "ready" status while actuation of the latter causes the previous menu level to appear on display 37. The changeable legends associated with variable function pushbuttons 40a through 40d may include those listed and explained in Table 1 below.

DEPR:

The NPAP Task 131 performs the functions of handling commands and data in the NPAP (Network Printing Alliance Protocol) format. The NPAP Task 131 supplies printer status information to any locally attached and/or network attached host computers 11 and receives requests for such information from the host computers 11. The NPAP Task 131 is activated periodically by a timer. When activated, NPAP Task 131 calls the Port BIOS 132 for the serial port 75, parallel port 77 and the Port BIOS 133 for the INA port 79 to determine if there is received data at one or more of those ports. If an NPAP command or command extension of the type to be described is received, the NPAP Task 131 responds through the appropriate port 75, 77, or 79 either directly or after obtaining needed information from another function in the printer controller 72. Before describing operation of the NPAP Task 131 in more detail, its state

as being "on" or "off" will be described.

DEPR:

When none of the interpreters 135 are running to provide data for subsequent rasterization and serialization in the printer, the Emulation Manager Task 136 looks for print data at a port 75, 77 or 79 to direct to the appropriate interpreter. In the absence of the NPAP Task 131, the Emulation Manager 136 calls Data Stream Manager 134 functions in order to transfer print data from the Port BIOS 132 or 133 to a buffer. If the NPAP Task 131 is "on" for a particular port, the Data Stream Manager 134 accesses data from an NPAP Task buffer for that port. The Emulation Manager 136 and Data Stream Manager 134 cooperate to associate a "job structure" with each print job received at a port 75, 77 or 79. The job structure is a data set associated with each print job and is held in memory for a time. The job structure includes an identification number for the print job, an area to record the number of sides of pages which have been printed, and information on resolution and other specifics. The job structure data is also capable of being modified during the printing process to update the status of the job. For example, as each side of a page to be printed is rendered by the print engine hardware, the job structure is modified to reflect completion thereof.

DEPR:

The Printer State Manager 140 is the task which first learns of events external to the code of controller 72 which may occur to printer 16. The Printer State Manager 140 notes, for example, if the printer cover has been opened and orchestrates providing this information to the operator panel 35 and to any other users of such information such as the NPAP Task 131. The Printer State Manager 140 will become aware of certain conditions due to hardware interrupts to the microprocessor of printer 16, while other status information is checked by the Printer State Manager 140 on a polling basis. Printer configuration changes, Device Status Alerts, and changes to the printer operator panel 35 are passed from the Printer State Manager 140 to the NPAP Task 131 for communication to attached host computer 11 using NPAP.

DEPR:

In the case of communication from the printer 16 to a host 11, the purpose of the flag byte is to provide a single byte which the host 11 can examine to obtain control information for the message and a quick view of the status of printer 16. As in the case of communications from a host 11 to the printer 16, the flag byte contains individually defined bits. Of present interest, bit six, if set, indicates that the message is from the NPAP Task 131 of the printer controller 72. Bit four, if set, means that the reply was required by the host 11 (solicited via flag bit four in the message from the host). Bits zero and one are set to the state the printer 16 is in at the time the reply is sent from the printer. The meanings of the conditions of these bits (bit one-bit zero) are: 00--printer 16 is operable normally with no alert conditions, 01--printer is operable but there is a condition the operator may want to know about (such as a low toner warning), 10--a condition exists which will prevent further printing which can be remedied by the operator, and 11--condition exists which will prevent further printing and which can be remedied only by a service/repair call.

DEPR:

In the case of a printer 16-to-host 11 reply message, the original command or logical unit identification of the host 11-to-printer 16 message that caused the reply is returned. If the message from the printer 16 is unsolicited (flag bit four cleared and flag bit six set) and the command byte is FX, then the packet represents an alert of type FX. For example, a Device Status Alert (DSA) is indicated by a command byte of FF.

DEPR:

When the Printer Panel program 51 loaded within host 11 begins running, its NPAP processor 60 attempts bi-directional communication with each potential NPAP printer found on the LAN 21 as well as with locally-attached printers. A potential NPAP printer such as 16, 16' or 16" is usually one having hard-coded model information placing it in a class of potentially NPAP-capable printers recognizable by host 11. In the preferred embodiment, the attempted bi-directional communication is accomplished by sending a non-printable, non-NPAP command to each printer, followed by sending an NPAP command to those

potentially NPAP-capable printers which respond to the first command. In practice, various techniques can be employed for determining if NPAP functionality is "on" at a particular printer, such as sending a request for status information and determining if an appropriately-formatted NPAP reply is received.

DEPR:

After establishing the identification of all connected NPAP-capable printers such as 16, 16' and 16" by communicating in NPAP commands, the NPAP Processor 60 of Printer Panel 51 requests device characteristics from each NPAP printer. NPAP Processor 60 also sends the appropriate NPAP commands to register for device status alerts and printer configuration changes of interest to Printer Panel 51.

DEPR:

Returning to FIG. 8, the button 303 is "depressed"; and the pictured printer is the locally-attached printer 16. The other printers accessible by the host are listed on buttons below the button 303. For example, the button 304 corresponds to the printer 16', and the button 305 corresponds to the printer 16". As indicated earlier, the NPAP Processor 60 (FIG. 2) sends the appropriate NPAP commands to register for device status alerts of interest. Typically, all alerts including operator panel change alerts and configuration changes are provided for the selected printer, while output alerts, operator intervention required alerts, device service required alerts, configuration change alerts and supplies alerts are provided for the non-selected printers.

DEPR:

In the more general case of processing various types of alerts illustrated in FIG. 10, after the Step 223 of FIG. 5, the GUI 53 parses the alert data in the WM.sub.-- USER message and determines (310) if the alert is an operator panel alert and if the panel alert is active for the printer associated with the message. If so, the GUI 53 parses the operator panel data and updates the operator panel display currently on the screen (311). If the alert data is not for an active panel, the GUI 53 determines if (312) the particular alert is active for the printer associated with the alert message. If not, the handling of the alert is complete (313). If the device status alert is active, the GUI 53 obtains the relevant device status alert information for the particular printer from the NPAP Processor 60 (314). The GUI 53 then parses (316) the device status alert information to determine if the alert contains an indication of an active error or a cleared error. This is determined by the NPAP Processor 60 which inspects the appropriate bits in the flag byte of the NPAP alert; and the active or cleared indication is passed from the NPAP Processor 60 to the GUI 53.

DEPR:

The GUI 53 next determines if the printer associated with the alert is the currently selected printer and the GUI Window is maximized (317). If so, the display is updated (318) to properly indicate error status of the printer, such as by changing the pictorial representation of the printer on the display. If there is a detailed status window open on the display, this information is updated, and if there is an appropriate error sound associated with the error, the sound is activated.

DEPR:

As can be seen from FIG. 8, if there is an alert associated with a non-selected printer, so that detailed status information is not placed on the screen, the user can in any event be alerted that there is an error condition at a printer accessible to the host. The user can then obtain further information by selecting that printer, elsewhere described herein.

DEPL:

After immediately returning the response enumerated above, an indefinite period of time may elapse before an event concerning printer 16 takes place which is to be reported to host 11 or before a user of host 11 selects one of the pushbutton fields 40a'-40d', 45' or 46' associated with replica 35'. An event which printer 16 reports to host 11 may result from a change in the operating condition or status of the printer (e.g. a paper jam) or from an operator input in the form of actuation of one of the pushbuttons 40a, 40b, 40c, 40d, 45 and/or 46 on the operator panel 35 of printer 16. Significantly,

host 11 need not poll any of the printers 16 to which it is connected in order to determine when such an event takes place.

CLPR:

1. A printing system including a computer having an associated monitor screen and a plurality of printers in bidirectional communication via a communications path with the computer, the computer including a programmed processor which controls an image appearing on the monitor screen, said image including printer status and alert information for a selected printer of the plurality of printers, said processor also being configured to simultaneously control said image so as to display in substantially real time an indication of an error condition occurring at one or more other printers of the plurality of printers, said plurality of printers receiving print data from said computer in print data packets, said computer receiving printer status and alert information from said plurality of printers that are interspersed with said print data packets, said plurality of printers automatically generating, without waiting to be polled, said printer status and alert information, and wherein said indication of said error condition is derived from said alert information.

CLPR:

2. The printing system as recited in claim 1, wherein said programmed processor is further configured to initially register with said plurality of printers for device status alerts.

CLPR:

5. A printing system including a computer having an associated monitor screen and a plurality of printers in bidirectional communication via a communications path with the computer, the computer comprising a programmed processor which controls an image appearing on the monitor screen, said image including detailed error information for a selected printer of the plurality of printers, said processor also being configured to simultaneously control said image so as to display in substantially real time a general indication of an error condition occurring at any one or more of the other printers of the plurality of printers, said plurality of printers receiving print data from said computer in print data packets, said computer receiving printer status and alert information from said plurality of printers that are interspersed with said print data packets, said plurality of printers automatically generating, without to be polled, said printer status and alert information, and wherein said indication of said error condition is derived from said alert information.

CLPR:

10. The printing system as recited in claim 3, further comprising: a third processing circuit at another one of said printers, said third processing circuit being configured to automatically generate, without waiting to be polled, a printer alert signal upon the occurrence of at least one pre-determined event occurring at its associated printer, said printer alert signal being transmitted, via said communications path, to said host computer in a data message that is interspersed between data packets containing print data that are transmitted from said host computer to one of said plurality of printers, said first processing circuit being further configured to receive and process said printer alert signal received from said third processing circuit and to automatically update the information being displayed on the monitor screen concerning the printer associated with said third processing circuit, thereby updating in substantially real time at said host computer all printer status alerts in connection with the printer associated with said third processing circuit regardless of the status of other data messages being transferred through said communications path.

CLPR:

11. The printing system as recited in claim 10, wherein said first processing circuit is further configured to initially register with both said second and third processing circuits for device status alerts that may occur at the printers associated with said second and third processing circuits.

CLPR:

12. The printing system as recited in claim 10, wherein said first processing circuit is further configured to maximize the window on said monitor screen in

the event that the currently selected printer at said host computer generates a printer alert signal that is communicated over said communications path, and, in the event that one of said plurality of printers other than the currently selected printer at said host computer generates a printer alert signal that is communicated over said communications path, a symbol indicating a device status alert condition is displayed on said monitor screen proximal to a button that corresponds to the printer which generated the printer alert signal.

CLPV:

a first processing circuit at said host computer, a second processing circuit at one of said plurality of printers, said first processing circuit being configured to simultaneously display on said monitor screen printer status and alert information of a selected printer of said plurality of printers and an indication of a general error condition occurring at one or more of the other printers of said plurality of printers and to receive and process a printer alert signal received from said second processing circuit via said communications path:

CLPV:

said second processing circuit being configured to automatically generate, without waiting to be polled, said printer alert signal upon the occurrence of at least one predetermined event occurring at its associated printer, said printer alert signal being transmitted, via said communications path, to said host computer in a data message that is interspersed between data packets containing print data that are transmitted from said host computer to one of said plurality of printers, said first processing circuit being further configured to automatically update the information being displayed on the monitor screen concerning the printer associated with said second processing circuit, thereby updating in substantially real time at said host computer all printer status alerts in connection with the printer associated with said second processing circuit regardless of the status of other data messages of said plurality of printers being transferred through said communications path.